
NT1R20 Off-Premise Station Analog Line Card

Introduction

The NT1R20 Off-Premise Station (OPS) Analog Line Card is an intelligent peripheral equipment (IPE) device that can be installed in either the NT8D37 IPE Module or the NT8D11 CE/PE Module. The OPS analog line card interfaces eight analog telephone lines with hazardous and surge voltage protection to the Meridian 1 switch. Each line interface is independently configurable by software control in the Single-line Telephone Administration program (LD 10).

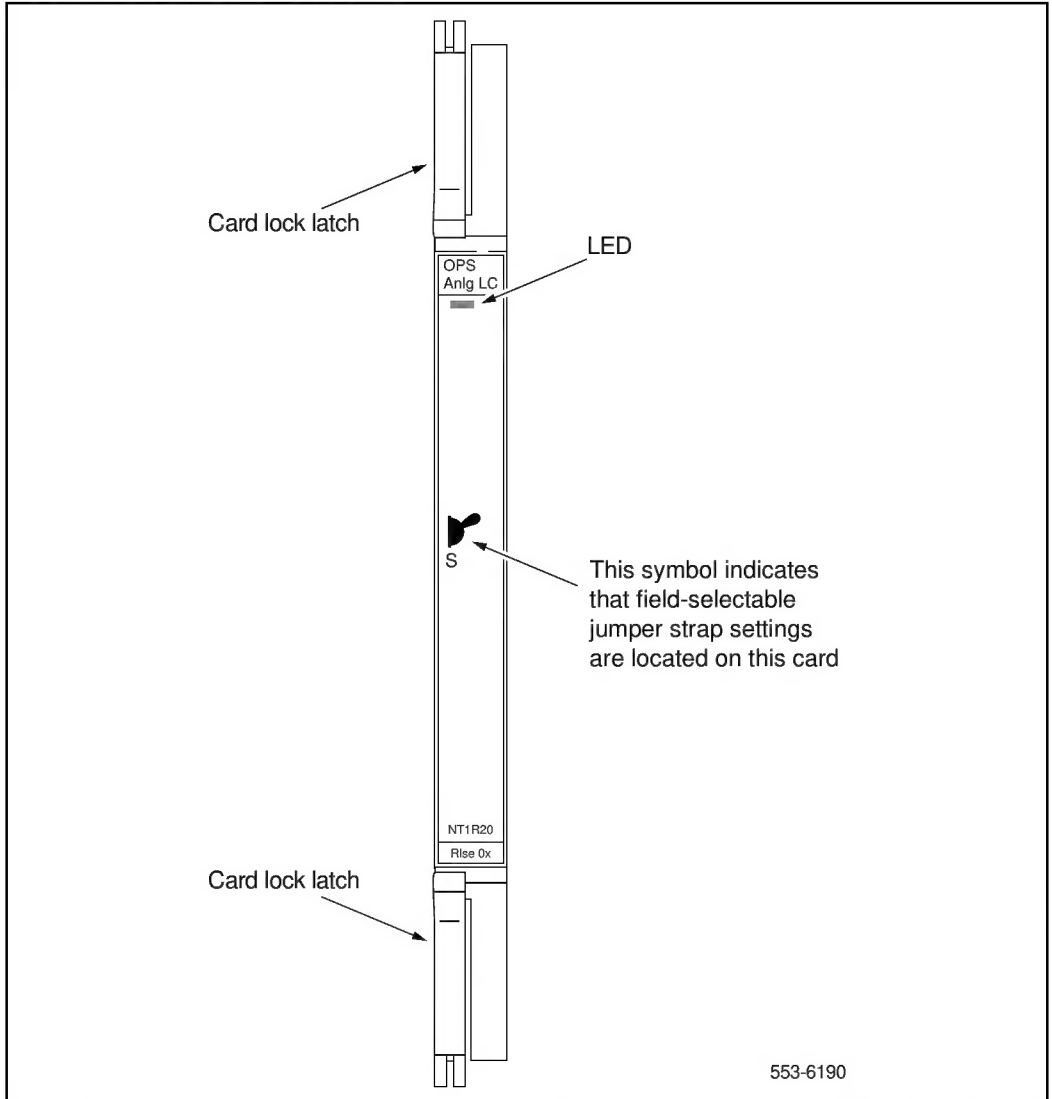
Physical description

The OPS analog line card mounts in any IPE slot. The line interface and common multiplexing circuitry is mounted on a 31.75 cm by 25.40 cm (12.5 in. by 10 in.) printed circuit board.

The OPS analog line card connects to the IPE backplane through a 160-pin connector shroud. The backplane is cabled to the input/output (I/O) panel on the rear of the module, which is then connected to the main distribution frame (MDF) by 25-pair cables. Telephone lines from station equipment cross connect to the OPS analog line card at the MDF using a wiring plan similar to that used for trunk cards. See *Meridian 1 system installation procedures* (553-3001-210) for termination and cross-connect information.

The faceplate of the card is equipped with a red light-emitting diode (LED) (see [Figure 16](#)). When an OPS analog line card is installed, the LED remains lit for two to five seconds while the self-test runs. If the self-test completes successfully, the LED flashes (off/on) three times and remains lit until the card is configured and enabled in software; then the LED goes out. If the LED does not follow this pattern or operates in any other manner, such as continually flashing or remaining weakly lit, the card should be replaced.

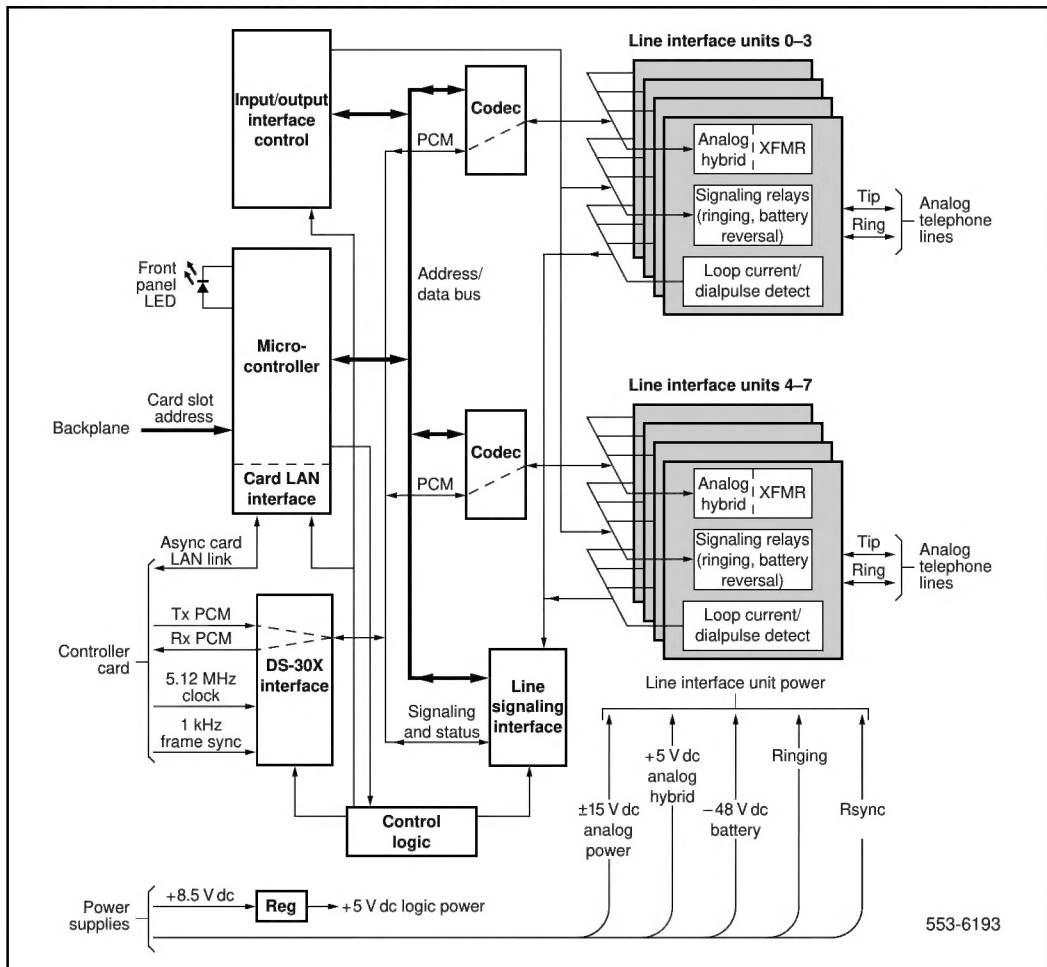
Figure 16
OPS analog line card—faceplate



Functional description

Figure 17 shows a block diagram of the major functions contained on the off-premise station (OPS) analog line card. Each of these functions are described on the following pages.

Figure 17
OPS analog line card—block diagram



Card interfaces

The OPS analog line card passes voice and signaling data over DS-30X loops and maintenance data over the card LAN link. These interfaces are discussed in detail in “Intelligent peripheral equipment line cards” on page 8.

Line interface units

The OPS analog line card contains eight identical and independently configurable line interface units (also referred to as circuits). Each unit provides impedance matching and a balance network in a signal transformer/analog hybrid circuit. Relays are also provided in each unit to apply ringing onto the line. Signal detection circuits monitor on-hook/off-hook signaling. Two codecs are provided for performing A/D and D/A conversion of line analog voiceband signals to digital PCM signals. Each codec supports four line interface units and contains switchable pads for control of transmission loss on a per unit basis. The following features are common to all units on the card:

- OPS or ONS (on-premise station) service configurable on a per unit basis
- terminating impedance (600 or 900 ohm) selectable on a per unit basis
- standard or complex balance impedance (600 or 900 ohm or 3COM or 3CM2) selectable on a per unit basis
- loopback of PCM signals over DS-30X network loop for diagnostic purposes

Card control functions

Control functions are provided by a microcontroller, a Card LAN link, and signaling and control circuits on the OPS analog line card.

Microcontroller

The OPS analog line card contains a microcontroller that controls the internal operation of the card and the serial card LAN link to the controller card. The microcontroller controls the following:

- reporting to the CE CPU via the card LAN link:
 - card identification (card type, vintage, and serial number)
 - firmware version
 - self-test status
 - programmed configuration status
- receipt and implementation of card configuration:
 - programming of the codecs
 - enabling/disabling of individual units or entire card
 - programming of input/output interface control circuits for administration of line interface unit operation
 - enabling/disabling of an interrupted dial tone to indicate call waiting
 - maintenance diagnostics
 - transmission loss levels

Card LAN interface

Maintenance data is exchanged with the Common Equipment CPU over a dedicated asynchronous serial network called the Card LAN link. The Card LAN link is described in the section “Intelligent peripheral equipment” on page 18.

The OPS analog line card has the capability of providing an interrupted dial tone to indicate that a message is waiting or that call forwarding is enabled. The line card (optionally) receives messages stating that these conditions exist over the Card LAN Interface and interrupts the dial tone when either of these conditions are detected.

Signaling and control

The signaling and control portion of the card provides circuits that establish, supervise, and take down call connections. These circuits work with the system CPU to operate the line interface circuits during calls. The circuits receive outgoing call signaling messages from the CPU and return incoming call status information over the DS-30X network loop.

Circuit power

The +8.5 V dc input is regulated down to +5 V dc for use by the digital logic circuits. All other power to the card is used by the line interface circuits. The ± 15.0 V dc inputs to the card are used to power the analog circuits. The +5 V dc from the module power supply is used for the analog hybrid. The -48.0 V dc input is for telephone set battery. Ringing power for telephone sets is 86 Vrms ac at 20 Hz on -48 V dc. The Rsync signal is used to switch the 20 Hz ringing on and off at the zero cross-over point to lengthen the life of the switching circuits.

Electrical specifications

This section lists the electrical characteristics of the OPS analog line card.

Analog line interface

Table 7 lists the electrical characteristics of OPS analog line card line interface units.

Table 7
OPS analog line card—electrical characteristics

Characteristic	Specification
Terminal impedance (TIMP)	600 or 900 ohms
Balance impedance (BIMP)	600 or 900 ohms, 3COM, or 3CM2
DC signaling loop length (max)	2300-ohm loop (including resistance of telephone set) with nominal battery of -48 V dc
Battery supply voltage	-42 to -52.5 V dc
Minimum detected loop current	16 mA
Ground potential difference	± 3 V
Line leakage	≥ 30 k ohms, tip-to-ring, tip-to-ground, ring-to-ground
AC induction rejection	10 V rms, tip-to-ring, tip-to-ground, ring-to-ground

Power requirements

Table 8 shows the maximum power consumed by the card from each system power supply.

Table 8
OPS analog line card—power requirements

Voltage	Tolerance	Current (max.)
±15.0 V dc	± 5%	150 mA
+8.5 V dc	± 2%	200 mA
+5.0 V dc	± 5%	100 mA
−48.0 V dc	± 5%	350 mA

Foreign and surge voltage protection

The OPS analog line card meets UL-1489 and CS03 over-voltage (power cross) specifications and FCC Part 68 requirements for hazardous and surge voltage limits.

Ringer limitations

The OPS line card supports up to three NE-C4A (3 REN) ringers on each line for either ONS or OPS applications. This is shown in [Table 9](#).

Table 9
OPS analog line card—ringer limitations

ONS Loop Range	Maximum Number of Ringers (REN)
0–10 ohms	3
> 10–460 ohms	2

OPS Loop Range	Maximum Number of Ringers (REN)
0–10 ohms	3
> 10–900 ohms	2
> 900–2300 ohms	1

Environmental specifications

[Table 10](#) shows the environmental specifications of the card.

Table 10
OPS analog line card—environmental specifications

Parameter	Specifications
Operating temperature	0° to +60° C (+32 to +140° F), ambient
Operating humidity	5 to 95% RH (non-condensing)
Storage temperature	–40° to +70° C (–40° to +158° F)

Connector pin assignments

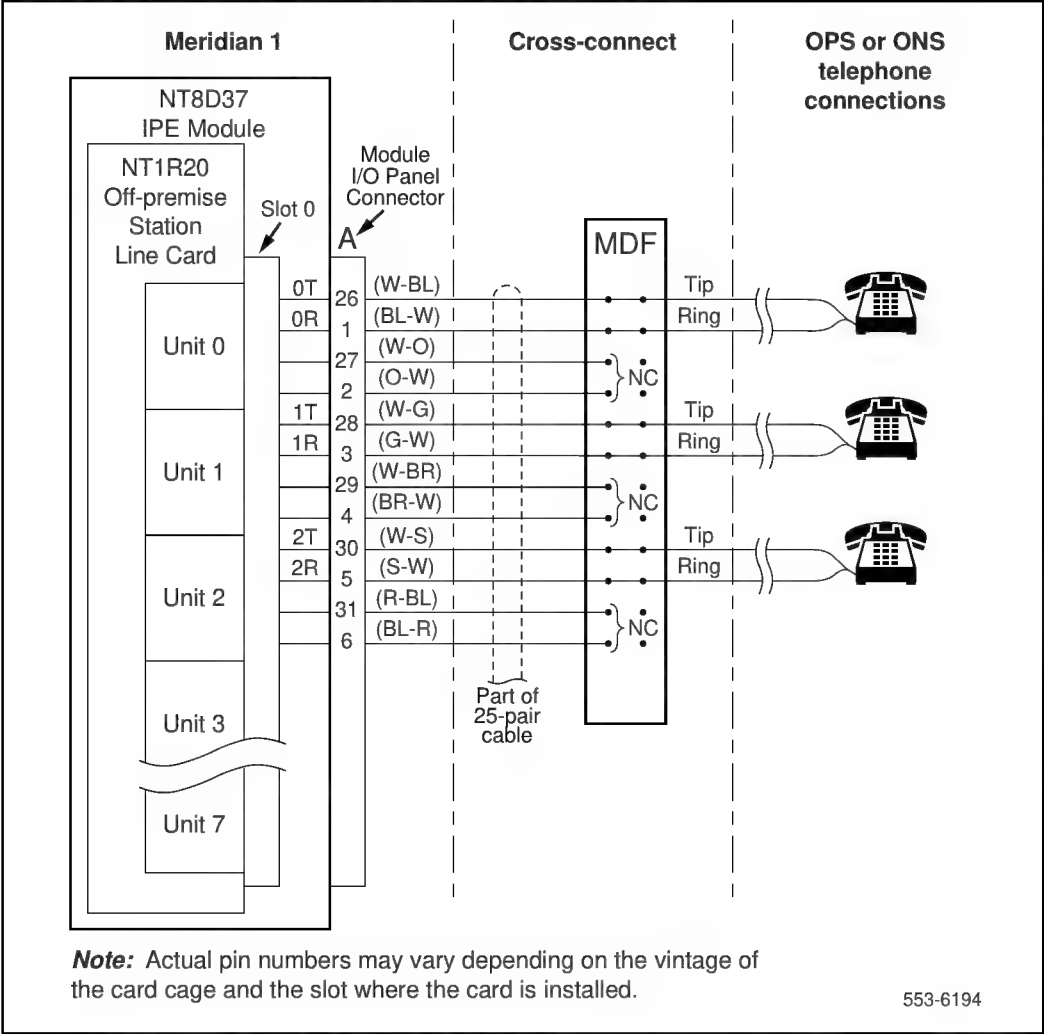
The OPS analog line card brings the eight analog phone lines to the IPE backplane through a 160-pin connector shroud. The backplane is cabled to the input/output (I/O) panel on the rear of the module, which is then connected to the main distribution frame (MDF) by 25-pair cables.

Telephone lines from station equipment cross connect to the OPS analog line card at the MDF using a wiring plan similar to that used for trunk cards. A typical connection example is shown in [Figure 18](#), and a list of the connections to the analog line card are shown in [Table 11](#). See *Meridian 1 system installation procedures* (553-3001-210) for complete I/O panel connector information and wire assignments for each tip/ring pair.

Table 11
OPS analog line card—backplane pinouts

Backplane Connector Pin	Signal	Backplane Connector Pin	Signal
12A	Unit 0, Ring	12B	Unit 0, Tip
13A	Unit 1, Ring	13B	Unit 1, Tip
14A	Unit 2, Ring	14B	Unit 2, Tip
15A	Unit 3, Ring	15B	Unit 3, Tip
16A	Unit 4, Ring	16B	Unit 4, Tip
17A	Unit 5, Ring	17B	Unit 5, Tip
18A	Unit 6, Ring	18B	Unit 6, Tip
19A	Unit 7, Ring	19B	Unit 7, Tip

Figure 18
OPS analog line card—typical cross connection example



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Configuring the OPS analog line card

The line type, terminating impedance, and balance network configuration for each unit on the card is selected by software service change entries at the system terminal and by jumper strap settings on the card.

Jumper strap settings

Each line interface unit on the card is equipped with two jumper blocks that are used to select the proper loop current depending upon loop length (see [Table 12](#)). For units connected to loops of 460 to 2300 ohms, both jumper blocks for that unit must have jumper blocks installed. For loops that are 460 ohms or less, jumper blocks are not installed. [Figure 19](#) shows the location of the jumper blocks on the OPS analog line card.

Before the appropriate balance network can be selected, the loop length between the near-end (Meridian 1) and the far-end station must be known. To assist in determining loop length, [Table 13](#) shows some typical resistance and loss values for the most common cable lengths for comparison with values obtained from actual measurements.

Software service changes

Individual line interface units on the OPS analog line card are configured to either OPX (for OPS application) or ONP (for ONS application) class-of-service (CLS) using the Single-line Telephone Administration program (LD 10). (See [Table 12](#).) LD 10 is also used to select unit terminating impedance and balance network impedance at the TIMP and BIMP prompts, respectively. The message waiting interrupted dial tone and call forward reminder tone features are enabled by entering data into the customer data block using LD 15. See the *X11 input/output guide* (553-3001-400) for LD 10 and LD 15 service change instructions.

Table 12
OPS analog line card—configuration

Application	On-premise station (ONS)			Off-premise station (OPS)			
Class of Service (CLS) (Note 1)	ONP			OPX			
Loop resistance (ohms)	0–460			0–2300 (Note 2)			
Jumper strap setting (Note 6)	Both JX.0 and JX.1 off			Both JX.0 and JX.1 off		Both JX.0 and JX.1 on	
Loop loss (dB) (Note 3)	0–1.5	>0–3.0	>2.5–3.0	0–1.5	>1.5–2.5	>2.5–4.5	>4.5–15
TIMP (Notes 1, 4)	600 ohms	600 ohms	600 ohms	600 ohms	600 ohms	600 ohms	600 ohms
BIMP (Notes 1, 4)	600 ohms	3COM	3CM2	600 ohms	3COM	3CM2	3CM2
Gain treatment (Note 5)	No						Yes

Note 1: Configured in the Single-line Telephone Administration program (LD 10).

Note 2: The maximum signaling range supported by the OPS analog line card is 2300 ohms.

Note 3: Loss of untreated (no gain devices) metallic line facility. Upper loss limits correspond to loop resistance ranges for 26 AWG wire.

Note 4: The following are the default software impedance settings:

	<u>ONP CLS</u>	<u>OPX CLS</u>
Termination Impedance (TIMP):	600 ohms	600 ohms
Balanced Impedance (BIMP):	600 ohms	3CM2

Note 5: Gain treatment, such as a voice frequency repeater (VFR) is required to limit the actual OPS loop loss to 4.5 dB, maximum. VFR treatment of metallic loops having untreated loss greater than 15 dB (equivalent to a maximum signaling range of 2300 ohms on 26 AWG wire) is not recommended.

Note 6: Jumper strap settings JX.0 and JX.1 apply to all eight units; "X" indicates the unit number, 0–7. "Off" indicates that a jumper strap is not installed across both pins on a jumper block. Store unused straps on the OPS analog line card by installing them on a single jumper pin as shown below:

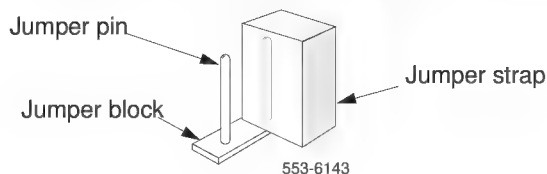
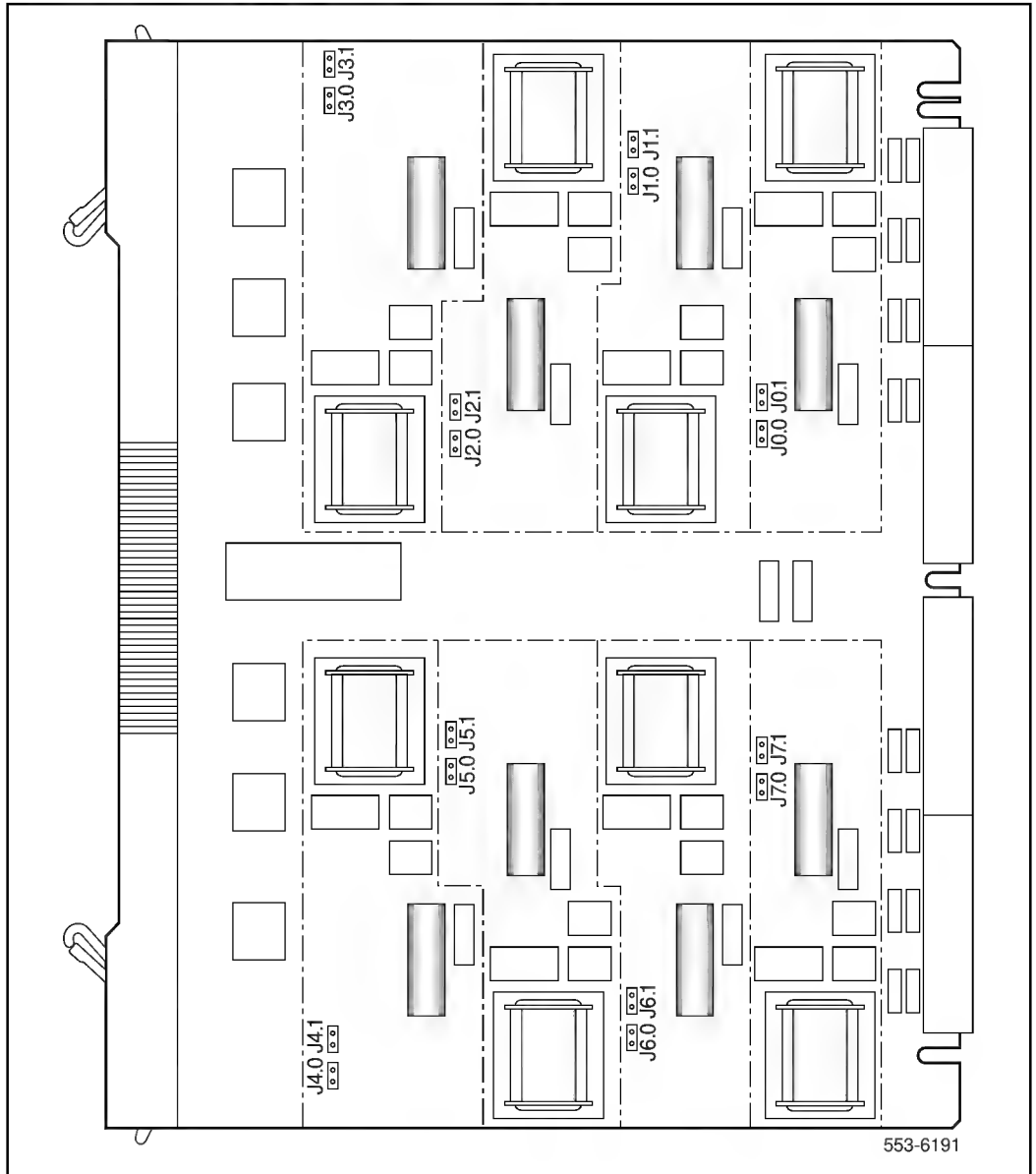


Figure 19
OPS analog line card—jumper block locations



Port-to-port loss configuration

The OPS analog line card provides transmission loss switching for control of end-to-end connection loss. Control of loss is a major element in controlling transmission performance parameters such as received volume, echo, noise, and crosstalk. The loss plan for the OPS analog line card determines port-to-port loss for connections between an OPS analog line card unit (port) and other Meridian 1 PE or IPE ports. LD 97 is used to configure the Meridian system for port-to-port loss. See the *X11 input/output guide* (553-3001-400) for LD 97 service change instructions.

The transmission properties of each line unit are characterized by the OPX or ONP class-of-service assigned in the Single-line Telephone Administration program (LD 10). A complete loss plan is given in *Summary of transmission parameters* (553-2201-182) where the appropriate port-to-port electrical loss may be determined for connections between any two Meridian 1 ports (lines, analog trunks, or digital trunks).

Table 13
OPS analog line card—cable loop resistance and loss

Cable length	Cable loop loss (dB) (non-loaded at 1kHz)			Cable loop resistance (ohms)		
	26 AWG	24 AWG	22 AWG	26 AWG	24 AWG	22 AWG
847 m (2800 ft)	1.5	1.2	0.9	231.4	144.2	90
1411 m (4600 ft)	2.5	2	1.6	385.6	240.3	150
1694 m (5600 ft)	3	2.4	1.9	462.8	288.3	180
2541 m (8300 ft)	4.5	3.7	2.8	694.2	432.5	270
8469 m (27800 ft)	15	12.2	9.4	2313.9	1441.7	900

Applications

Off-premise station application

The NT1R20 Off-Premise Station (OPS) Analog Line Card is designed primarily to provide an interface for Meridian 1 off-premise station lines. An OPS line serves a terminal—typically, but not exclusively, a telephone set—remote from the PBX either within the same serving area as the local office or through a distant office. The line is not switched at these offices; however, depending on the facilities used, the local office serving the OPS station may provide line functions such as battery and ringing. Facilities are generally provided by the local exchange carrier (OPS pairs are usually in the same cable as the PBX-CO trunks). The traditional OPS scenario configuration is shown in [Figure 20](#).

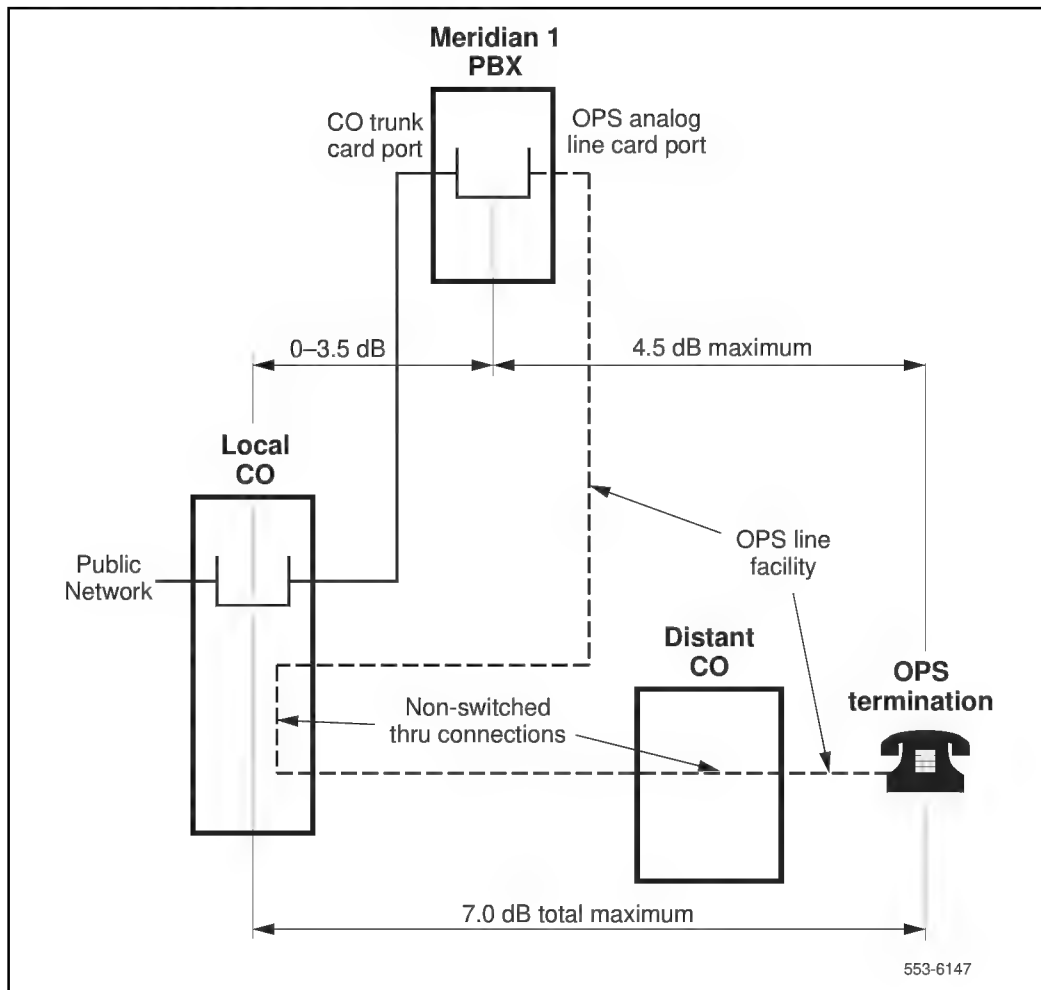
Note: OPS service should not be confused with off-premise extension (OPX) service. OPX service is the provision of an extension to a main subscriber loop bridged onto the loop at the serving CO or PBX. Additionally, OPX as used to denote off-premise extension service should not be confused with the OPX class-of-service assigned in the Single-line Telephone Administration program (LD 10).

Other applications

The operating range and built-in protection provisions of the OPS analog line card make it suitable for applications that are variants on the traditional configuration shown in [Figure 20](#). The following are some examples of such applications:

- a PBX in a central building serving stations in other buildings in the vicinity, such as in an industrial park (often called a campus environment). Facilities may be provided by the local exchange carrier or may be privately owned. Protection may or may not be a requirement.
- termination to other than a telephone set, such as to a key telephone system
- individual circuits on the OPS analog line card may also be configured as ONS ports in LD 10:
 - to have ONS service with hazardous and surge voltage protection (not available on other Meridian 1 analog line cards)
 - to use otherwise idle OPS analog line card ports

Figure 20
Traditional OPS application configuration



Transmission considerations

The transmission performance of OPS lines is dependent on the following factors:

- the Meridian 1 port-to-port loss for connections between OPS ports and other Meridian 1 ports
- the transmission parameters of the facilities between the Meridian 1 OPS port and the off-premise station or termination
- the electrical and acoustic transmission characteristics of the termination

These factors must be considered when planning applications using the OPS analog line card. They are of particular importance when considering configurations other than the traditional OPS application shown in [Figure 20](#). The discussion which follows is intended to provide basic transmission planning guidelines for various OPS applications.

Port-to-port loss

Loss is inserted between OPS analog line card ports and other Meridian 1 ports in accordance with the Meridian 1 loss plan. This plan determines the port-to-port loss for each call. When a port is configured for OPX class-of-service, loss is programmed into the OPS analog line card on a call-by-call basis. When configured for ONP class-of-service, an OPS analog line card port is programmed to a value that is fixed for all calls. However, the loss in the other port involved in the call may vary on a call-by-call basis to achieve the total loss scheduled by the plan. *Summary of transmission parameters* (553-2201-182) shows the specific loss for each possible port-to-port combination.

For satisfactory transmission performance, particularly on connections between the public network and an OPS termination, it is recommended that facilities conform to the following:

- Total 1 kHz loss from the local serving CO to the OPS terminal should not exceed 7.0 dB. Of that total, the loss in the facility between the PBX and the terminal should not exceed 4.5 dB (see [Figure 20](#)).

The following requirements are based on historic inserted connection loss (ICL) objectives:

- PBX–CO trunk: 5 dB with gain; 0–4.0 dB without gain
- OPS line: 4.0 dB with gain; 0–4.5 dB without gain

In recent times economic and technological considerations have led to modifications of these historic objectives. However, the loss provisions in the PBX for OPS are constrained by regulatory requirements as well as industry standards; thus, they are not designed to compensate for modified ICL designs in the connecting facilities.

- The attenuation distortion (frequency response) of the OPS facility should be within ± 3.0 dB over the frequency range from 300 to 3000 Hz. It is desirable that this bandwidth extend from 200 to 3200 Hz.
- The terminating impedance of the facility at the OPS port should approximate that of 600 ohm cable.

If the OPS line facility loss is greater than 4.5 dB but does not exceed 15 dB, line treatment using a switched-gain voice frequency repeater (VFR) will extend the voice range.

The overall range achievable on an OPS line facility is limited by the signaling range (2300 ohm loop including telephone set resistance). Signaling range is unaffected by gain treatment; thus, gain treatment can be used to extend the voice range to the limit of the signaling range. For example, on 26AWG wire, the signaling range of 2300 ohms corresponds to an untreated metallic loop loss of 15 dB. Gain treatment (such as a VFR) with 10.5 dB of gain would maintain the OPS service loss objective of 4.5 dB while extending the voice range to the full limit of the signaling range:

$$\begin{array}{rcl}
 & 15.0 \text{ dB} & \text{(loss corresponding to the maximum signaling range)} \\
 - & 4.5 \text{ dB} & \text{(OPS service loss objective)} \\
 \hline
 = & 10.5 \text{ dB} & \text{(required gain treatment)}
 \end{array}$$

The use of dial long line units to extend the signaling range of OPS analog line cards beyond 15 dB is not recommended.

Termination transmission characteristics

The loss plan for OPS connections is designed so that a connection with an OPS termination will provide satisfactory end-to-end listener volume when the OPS termination is a standard telephone set. The listener volume at the distant end depends on the OPS termination transmit loudness characteristics, and the volume at the OPS termination end depends on the OPS termination receive loudness characteristics. With standard telephone sets, these characteristics are such that satisfactory—if not optimum—performance is achievable within the above noted objectives for connecting facilities.

A feature of many (though not all) standard telephone sets is that the loudness increases with decreased current. Thus, as the line (Meridian 1 to OPS termination) facility gets longer and lossier, the increased loudness of the set somewhat compensates for the higher loss, assuming direct current feed from the PBX with constant voltage at the feeding bridge. However, this compensation is not available when the following occurs:

- the termination is a non-compensating telephone set
- the OPS port is served by a line card using a constant-current feeding bridge
- the OPS termination is to telephone sets behind a local switch providing local current feed, such as a key telephone system

OPS line terminations with loudness characteristics designed for other applications may also impact transmission performance. For example, wireless portables loudness characteristics are selected for connections to switching systems for wireless communication systems; if deployed in an OPS arrangement without due consideration for these characteristics, the result could be a significant deviation from optimum loudness performance.

